Abstracts of Technical Articles From Bell System Sources

Notes on the Effect of Solar Disturbances on Transatlantic Radio Transmission.[1] CLIFFORD N. ANDERSON. In 1923 when the relation between abnormal long-wave radio transmission and solar disturbances was first noted, the outstanding abnormality was the great decrease in night time signal field strength accompanying storms in the earth's magnetic field. There was a slight increase in daylight signal field but this was distinctly secondary to the effect upon night field. Previous to 1927, data on signal fields were limited to one set of measurements a week, and although daylight signal field strengths were higher during periods of increased magnetic activity, it was somewhat difficult to determine the effect of individual storms. The present notes show the effects of individual storms of 60-kc transatlantic radio transmission and also give some indication as to their effect on short-wave radio transmission.

The Mutual Impedance Between Adjacent Antennas.[2] CARL R. ENGLUND and ARTHUR B. CRAWFORD. The simple theory for the computation of reflecting or multibranch antenna systems is sketched. If the points at which observations of electrical quantities are to be made are definitely specified, a knowledge of the self and mutual impedances (properly defined) between antennas is sufficient to make the computations determinate. Of the circuit constants, the most useful and accessible is the antenna current ratio

$$K_{12} = \frac{I_2}{I_1} = K_0 e^{i(\phi - (2\pi d/\lambda))}$$

and in the work here reported ϕ has been measured in the range 0.33 λ to 1 λ. Experiment has shown that in this range ϕ is that theoretically calculable for a Hertzian doublet. Actually this range is equivalent to $\lambda/3$ to ∞. The discussion of experimental procedure is purposely thorough.

An Experimental Method for the Determination of the Ballistic Demagnetization Factor.[3] DONALD FOSTER. A method is described for experimentally determining the ballistic demagnetization factor. By means of a double search coil of novel design the magnetization and

[1] *Proceedings of the Institute of Radio Engineers*, September, 1929.
[2] *Proceedings of the Institute of Radio Engineers*, August, 1929.
[3] *Philosophical Magazine*, September, 1929.

the magnetic field intensity are determined from ballistic galvanometer deflections. While the discussion refers mainly to circular cylinders, the scheme is adaptable to specimens of other shapes. It is particularly designed to obtain accurate measurements of field intensity in cylinders of small diameter.

Details of a special design are given.

Curves are given which illustrate the variation of the demagnetization factor with the magnetization, as well as the dependence of this relation on the material and on the dimensional ratio.

The Use of Continued Fractions in the Design of Electrical Networks.[4] THORNTON C. FRY. In U. S. Patent No. 1,570,215 and in several technical papers by Bartlett and Cauer it has been shown that continued fractions can often be used in designing networks with preassigned impedances. The chief difficulty of the method has been that it frequently required the structures to contain negative resistances, inductances or capacities and therefore the results, though correct in theory, were often worthless in practice because the networks could not be constructed.

The present paper removes this difficulty in virtually all cases where the analytic character of the desired impedance is known, that is, where it can be represented by a formula and not merely by a graph. In such cases the choice of a type of structure, as well as the assignment of values to the elements, becomes almost a matter of routine with the definite assurance in advance that no negative elements will be required.

A Voltage Regulator for Gas Discharge X-Ray Tubes.[5] F. E. HAWORTH. This note describes a device used in connection with a gas discharge x-ray tube, to regulate the voltage across it by automatically adjusting a mercury valve between the tube and the pumps, thus controlling the pressure of the gas. It has been used with tubes of the Hadding and Shearer types and has operated satisfactorily for more than a year. It was designed to replace the regulator described by Bozorth, which is similar in principle but has certain disadvantages, for example the moving parts have high inertia and adjustment is required when the atmospheric pressure changes.

The Significance of the Hydrogen Content of Charcoals.[6] H. H. LOWRY. Most studies of the thermal decomposition of hydrocarbons

[4] *Am. Math. Soc. Bull.*, July–August, 1929.
[5] *Journal of the Optical Society of America*, August, 1929.
[6] *Journal of Physical Chemistry*, September, 1929.

are confined to an examination of the composition of the liquid and gaseous products. Among exceptions to this generalization may be mentioned the interest in coke, carbon black, and charcoal. Even in these cases the physical properties rather than the chemical composition are regarded as the factors which determine their suitability for specific uses. However, in an earlier paper it was pointed out that certain physical properties of a group of charcoals were rather simply related to the per cent hydrogen which was contained in them as determined by ultimate analysis. This group of charcoals was prepared in a gas-fired furnace from a single, specially-selected lot of anthracite coal. As stated in this earlier paper, careful consideration of the commercial records taken at the time of preparation indicated that the hydrogen content was probably determined by the maximum temperature to which the samples were heated during their preparation. The hydrogen contents ranged from 0.21 to 0.53%, while the probable range of maximum temperature was 900° to 1200°. The presence of hydrogen in these charcoals was shown to be consistent with a point of view that so-called "amorphous" carbons are hydrocarbons of low hydrogen content built up of polymerized residues from the thermal decomposition of hydrocarbons of greater hydrogen content. Since the significance of the hydrogen content of charcoals has been generally overlooked, the present study was undertaken in order to evaluate the factors which may ordinarily be varied in the preparation of charcoals for various purposes. The factors which were independently varied in this study were the maximum temperature, the time of heating, the atmosphere surrounding the sample during heating and the raw material. To a limited extent the effect of previous heat treatment was also determined. A later paper will give the results of the study of the correlation of hydrogen content and some adsorptive properties of charcoals prepared under carefully controlled conditions.

Beginnings of Telephony.[7] FREDERICK LELAND RHODES, Outside Plant Development Engineer, Department of Development and Research, American Telephone and Telegraph Company.

It is only within the past decade or so that science and business have become subjects for literature. Somehow these great phases of human endeavor have been sadly neglected in the literary world until very recently, and now it seems as though, conscious of the lack of good literature in these fields, engineers, scientists and business executives are making up for lost time. Frederick Leland Rhodes has written a new book which undoubtedly will be of great assistance to those in the

[7] Harper & Brothers, New York and London, 1929.

telephone industry, for it supplies them with an accurate picture of the technical background of a great industry. It is greatly to the advantage of an individual to know the history of his own business, and Mr. Rhodes has supplied it in an interesting form, thoroughly accurate and readable. No effort has been made to set down the more recent achievements in the world of telephony, but only to carry each chapter to what might be termed the "middle period" in development. There are many phases of the telephonic art which have not been touched upon in the volume, but at the same time, one is not conscious of any lack in this respect as one reads through its interesting pages.

Any volume is the better off for illustrations, and Mr. Rhodes' book is generous in that it carries fifty-four illustrations scattered through 260 pages.

The first portion of the book naturally deals with Alexander Graham Bell and occupies three chapters. Following this we have two chapters called "The Bell Patents." As General John J. Carty, Vice President of the American Telephone and Telegraph Company, says: "Never before had the claims of an inventor been subjected to such exhaustive litigation and judicious scrutiny, and never before did an inventor receive such a complete and dramatic vindication." The remainder of the fourteen chapters deals with the truly romantic progress of telephone plant, its improvements and expansion over a term of years when telephony was young and the road was fraught with difficulty. Of special interest are the numerous references to original and authentic sources, and in this regard the author has unquestionably used great care and much labor in order to give his reader the most accurate information possible, thus more truly gaining his end of supplying a concrete picture of the younger days of a great industry.

Mr. Rhodes' volume is a great contribution, not only to the literature of telephony, but also to that rapidly growing library which contains in its pages the romance of business in America. As a library reference book it will be valuable to the technical student. Any member of the Bell System would do well to familiarize himself with this work, not only because it will help him in his job, but because he will find it a really interesting story.

Further Note on the Ionization in the Upper Atmosphere.[8] J. C. SCHELLENG. In this paper Mr. Schelleng records certain considerations that were omitted from a previous paper, which omission resulted in some difficulty.

[8] *Proceedings of the Institute of Radio Engineers*, August, 1929.

Transmission Networks and Wave Filters.[9] T. E. SHEA. In this book is summarized the research and experience of the Bell System in the application of electric wave filters, equalizers, balancing networks and similar electrical systems. The preface discusses the nature of the signals transmitted over communication systems and a statement of the principal ways in which selective networks are used to modify signal transmission. A detailed example of the application of selective networks to an actual long distance telephone circuit gives specific engineering requirements and limitations.

The next portion of the book deals with some of the more general principles governing network analysis. The engineering terms used to evaluate network performance are described and a number of general theorems and equivalences which simplify the analytic treatment of networks are demonstrated. A considerable discussion is also given of the characteristics of the elementary two-terminal networks most used as constituents of larger structures.

With this background the author is now ready to consider the properties of wave filters. Conditions for free transmission and attenuation in ladder networks are set up and the particular networks of chief practical importance are described in detail. The various structures revealed by this listing differ widely among themselves as regards propagative and impedance characteristics even when they transmit the same frequency bands. Since the ideal network characteristics seldom correspond exactly to any one of these structures, filter requirements are usually met most efficiently by composite networks, containing sections of several different types. The author describes the conditions which must be satisfied before different sections are joined together and gives several examples of methods of computing the performance of such composite structures.

This treatment of networks deals only with their response to steady single-frequency electrical impulses. It cannot be applied directly to communication systems, since signals are of more complicated wave forms and are transient in character. In the last portion of the book therefore, the author discusses the use of Fourier analysis in relating the characteristic of the network computed on a steady-state basis to its response to a transient impulse of arbitrary character.

Some Principles of Broadcast Frequency Allocation.[10] L. E. WHITTEMORE. This paper discusses some of the technical factors which must be considered in the allocation of frequencies to broadcasting stations

[9] D. Van Nostrand Company, New York.
[10] *Proceedings, Institute of Radio Engineers*, August, 1929.

in such a way as to provide the best possible coverage of a given country or continental area.

A given frequency or channel can be used for either of two kinds of service; (1) by one station, exclusively, to give high grade service to the immediate locality and opportunity for service over broad rural areas when transmission conditions are good, and (2) by two or more stations simultaneously, to give local service to a number of separate regions, each of rather restricted area. The problem, therefore, involves a determination of (1) the proper balance between the two kinds of service, rural and urban, and (2) the proper basis for the apportionment of the assignments.

Reference is made to the basis of apportionment of radio broadcasting assignments laid down in the U. S. Radio Act of 1927, and to certain suggestions which have been made for the apportionment of broadcasting frequency assignments among the countries of Europe.

A brief discussion is given of the relation between field intensity, or signal strength, and distance of transmission at broadcast frequencies. The paper also discusses briefly the effects produced in the case of (1) a single station operating exclusively on a "clear" channel, and (2) two or more stations operating simultaneously on the same channel.

It is suggested that the distribution of assignments on "clear" channels, in a given continental area be made proportional to the population of each of several large geographical units or zones and that the distribution of assignments on "multiple assignment" channels be made to comparatively small geographical units in proportion to their areas.